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and good. The particular character of the reaction which would have been forthcoming had it been the former will now be changed, but in its new rôle it is still a factor in the situation. I shall alter the reagent which I was about to add, etc.

We reach, then, the following conclusion as the result of the analysis given. When a thing makes claim, however tentatively, to a certain character, and is of value only in so far as it possesses that character, the validating of this claim will lead to its being judged real, the invalidating to its being judged unreal. On the other hand, provided this particular nature is not the exclusive point of interest, the result of the further testing does not lead to the raising of the question of reality one way or the other. The truth or falsity of the initial hypothesis is not as such responsible for the application of the additional predicates. The judgments were correct or incorrect, and that is all there is to it.

Another way of putting the matter is to say that reality and unreality are evaluative terms. This has two important results. In the first place, the old problem of being as usually conceived, is meaningless. The determination of the ultimate character of reality, the accepted task of the metaphysician, is a useless quest, for reality is nothing, has no character, but is merely a generic term for the fact that in experience many things are evaluated in a certain way, that certain value judgments take place. The distinction between appearance and reality as usually stated vanishes, for they are relative terms, not absolute. On the other hand, contrary to the opinion of Professor Sheldon, unreality can not be demolished. Like substance, it can merely be defined. Unreality in any absolute sense vanishes, for it should never have existed. But that things may have the value of being unreal, as they may have the value of being good or true, is proved by every-day experience.

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TELEOLOGY IN COSMIC EVOLUTION: A REPLY TO PROFESSOR WARREN

IN a recent essay[1] Professor Howard C. Warren has touched on the problem of fitness of the environment and, while analyzing what he takes to be the logical foundation of a belief in the teleology of inorganic nature, has associated with my writings certain arguments which he easily shows to be fallacious. His principal comment is to be found in the following lines: "There is, however, a fundamental scientific objection to this mode of reasoning. Admitting that inorganic conditions are peculiarly suitable to the maintenance of life as actually constituted, it may nevertheless be argued that under a different set of inorganic conditions a different type of organism might have arisen for which those alternative conditions would have proved just as favorable.'' In addition Professor Warren objects that inorganic teleology is founded on particular rather than on general facts or considerations and, further, that unfitness is never taken into account.

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[1] This JOURNAL, Vol. XIII., pages 65, 66.

I can not help thinking that my critic has been hasty in supposing that any man of science, approaching this subject from the frontiers of physics and chemistry, could to-day hold such silly views. However that may be, these are not my opinions; and without entering into a profitless discussion of the responsibility for Professor Warren's misconception of my conclusions upon this subject, which may very well be either mine or his, I am anxious to point out the facts which he has overlooked, and thus summarily to make out what I conceive to be the true case for inorganic teleology.

Putting aside all vain speculations about other possible worlds in which matter may have different properties and energy different forms, we can see that in the course of cosmic evolution water and carbon dioxide have necessarily found a place on the surface of the earth. Under these circumstances the properties of the two compounds and of their three constituent elements have caused these substances to be the principal factors in both geological and organic evolution.

The first fact to be noted is that these properties make up a unique ensemble of singular physical and chemical characteristics. Thus the latent heat of vaporization of water is the highest known latent heat of vaporization, the solvent action of water the greatest of solvent actions, the capillary phenomena of aqueous systems the most extensive of capillary phenomena. Again the solubility of carbon dioxide in water is such that it is everywhere evenly distributed between the atmosphere and aqueous liquids. And again the three elements form the greatest number and variety of chemical compounds, enter into the greatest variety of chemical reactions, and involve in these the greatest transformations of energy which are known to chemistry. In establishing the uniqueness of this ensemble of properties all of the general properties of matter, not merely certain particular properties, have been considered. Particular properties have been examined only when they involve the *relation* of water to carbon dioxide or of one of the three elements to the others.[2]

[2] See ''The Fitness of the Environment,'' Chapters III., IV., V., and VI. New York. 1913.

Secondly, it must be understood that the world of physics and chemistry consists exclusively of systems. This was established by Willard Gibbs, and is now one of the recognized postulates of science. Systems, in turn, are made up of phases and components; they are characterized by concentrations and by different forms of activity—especially heat and pressure. Above the sphere of the molecule and below that of the organism science knows nothing else in the world.[3]

Finally, a teleological conclusion, the unique ensemble of properties is uniquely favorable to the existence of systems; it favors number, diversity, and durability of systems, of their phases, components, and activities; and no other elements and compounds even remotely approach such fitness. This conclusion depends upon the evidence of a great variety of phenomena such as the stability of temperature on the earth, the rapidity of the meteorological cycle, the richness and variety of dissolved material in the ocean, the penetration of water into the soil, as well as directly upon some of the unique properties themselves, such as the chemical characteristics of the three elements, and the nature of the transformations of energy which accompany their reactions. Among all the general properties which have been investigated I can not find a single instance of unfitness for systems in general. In short the arrangement of the properties of matter among the elements is such as to make possible the production, in every respect physically intelligible, of much rather than little or of more rather than less in the course of evolution.

Such are the facts: I will add one opinion. This relationship between the properties of the three elements and the general characteristics of systems appears to be exclusively teleological; for neither of the terms of the relationship is liable to modification in time. As they now are so the elements were originally determined; and systems will be systems as long as mass is mass.

I do not doubt that Professor Warren is quite right in thinking, like every one else, that life would be different in another place. But whether it could use silicon instead of carbon, who shall say? I know, however, what chemists will guess. The fact is that life, if still possible under other conditions, would be restricted by any change that excluded water or carbonic acid from the environment, or any of their peculiar properties from the constitution of these substances and their elements.

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[3] *Loc. cit.*, Chapter VII. "The Functions of an Environment," *Science*, N. S., Vol. XXXIX, pages 524–527 (1914).